

# L1681

## ■ Features of L1681 Series

- 16 characters × 1 line
- STN LCD is used
- 5×7 dot matrix + cursor
- 1/16 duty
- 5V single power supply

## ■ Specification

### A. Mechanical Characteristics

Item	Specifications	Unit
Module size (H×V×T) (Reflective / built-in EL backlight type)	151.0×40.0×11.3	mm
Module size (H×V×T) (Built-in LED backlight type)	151.0×40.0×15.8	mm
Viewing area (H×V)	120.0×23.0	mm
Character size (5×7 dot, H×V)	6.0×12.715	mm
Dot size (H×V)	1.152×1.765	mm
Dot space	0.06	mm
Center to center dimension of mounting holes (H×V)	143.0×32.0	mm
Weight (Reflective type)	60	g
Weight (Built-in LED backlight type)	75	g
Weight (Built-in EL backlight type)	65	g

H: Horizontal, V: Vertical, T: Thickness (max.)

### B. Absolute Maximum Ratings

$V_{SS} = 0V$

Item	Symbol	Conditions	Min.	Max.	Unit
Power supply voltage	$V_{DD}$		-0.3	7.0	V
	$V_{LC}$		$V_{DD} - 13.5$	$V_{DD} + 0.3$	V
Input voltage	$V_{IN}$		-0.3	$V_{DD} + 0.3$	V
Operating temp.	$T_{opr}$		0	+50	°C
Storage temp.	$T_{stg}$		-20	+60	°C
Storage humidity		≤ 48 hrs	+20	+85	%RH
		≤ 1000 hrs	+20	+65	%RH

### C. Electrical Characteristics

$V_{DD} = 5V \pm 5\%$   $V_{SS} = 0V$   $T_a = 0^\circ\text{C to } 50^\circ\text{C}$

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	$V_{DD}$		4.75	5.00	5.25	V
	$V_{DD} - V_{LC}$		1.5	—	11.0	V
* Input voltage	High $V_{IH1}$		2.2	—	$V_{DD}$	V
	Low $V_{IL1}$		0	—	0.6	V
** Output voltage	High $V_{OH1}$	$-I_{OH} = 0.205\text{ mA}$	2.4	—	—	V
	Low $V_{OL1}$	$I_{OL} = 1.2\text{ mA}$	—	—	0.4	V
Current consumption	$I_{DD}$	$T_a = 25^\circ\text{C}$ $V_{DD} = 5V$ $V_{LC} = 0.25V$	—	1.8	3.0	mA
	$I_{LC}$		—	0.3	1.0	mA
Clock oscillation frequency	$f_{osc}$	Resistance oscillation	140	220	300	kHz

\* Applied to DB<sub>0</sub>~DB<sub>7</sub>, E, RW, RS

\*\* Applied to DB<sub>0</sub>~DB<sub>7</sub>

## D. Optical Characteristics (STN gray type)

### D-1 Reflective type

$T_a = 25^\circ\text{C}$ ,  $V_{opr} = 4.75V$

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Viewing angle	$\theta_1$	$C \geq 2.0$ $\varnothing = 0^\circ$	—	—	-25	deg.
	$\theta_2$		50	—	—	
	$\theta_2 - \theta_1$		75	—	—	
Contrast	C	$\theta = 5^\circ$ , $\varnothing = 0^\circ$	2	4	—	—
Response time(rise)	$t_{on}$	$\theta = 0^\circ$	—	180	270	ms
Response time(fall)	$t_{off}$	$\varnothing = 0^\circ$	—	250	380	
Response time(rise)	$t_{on}$	$\theta = 0^\circ$ , $\varnothing = 0^\circ$ $T_a = 0^\circ\text{C}$	—	400	600	ms
Response time(fall)	$t_{off}$	$V_{opr} = 5.0V$	—	720	1100	

### D-2 Transflective type

$T_a = 25^\circ\text{C}$ ,  $V_{opr} = 4.75V$ , Backlight OFF

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Viewing angle	$\theta_1$	$C \geq 2.0$ $\varnothing = 0^\circ$	—	—	-20	deg.
	$\theta_2$		45	—	—	
	$\theta_2 - \theta_1$		65	—	—	
Contrast	C	$\theta = 5^\circ$ , $\varnothing = 0^\circ$	2	4	—	—
Response time(rise)	$t_{on}$	$\theta = 0^\circ$	—	180	270	ms
Response time(fall)	$t_{off}$	$\varnothing = 0^\circ$	—	250	380	
Response time(rise)	$t_{on}$	$\theta = 0^\circ$ , $\varnothing = 0^\circ$ $T_a = 0^\circ\text{C}$	—	400	600	ms
Response time(fall)	$t_{off}$	$V_{opr} = 5.0V$	—	720	1100	

## E. Recommended Operating Voltage

### (STN gray type)

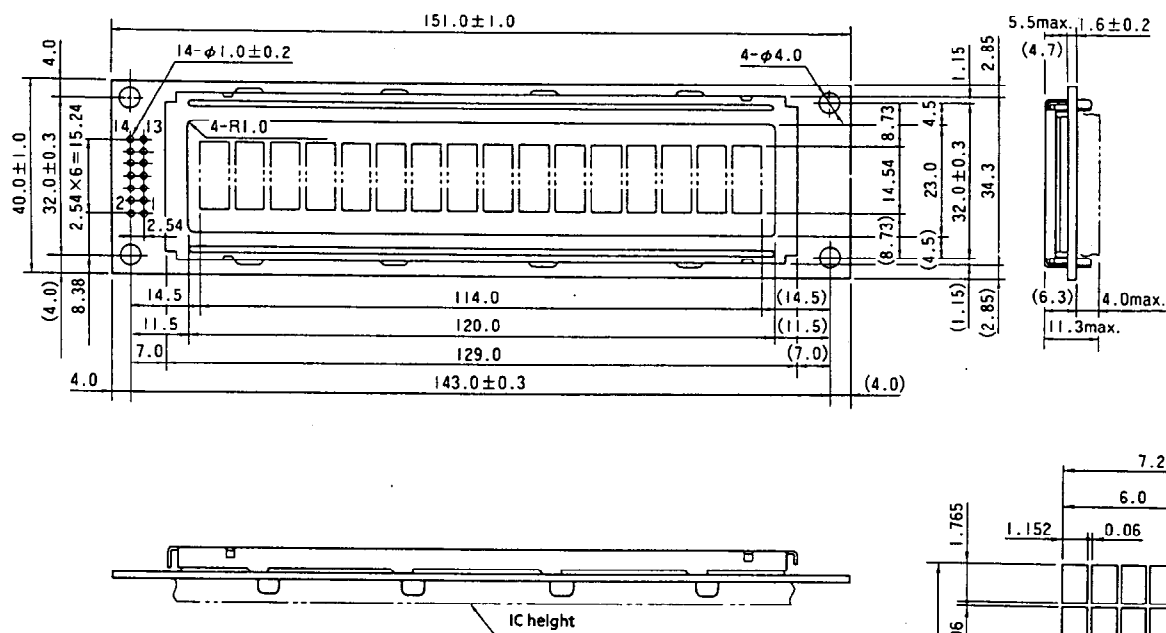
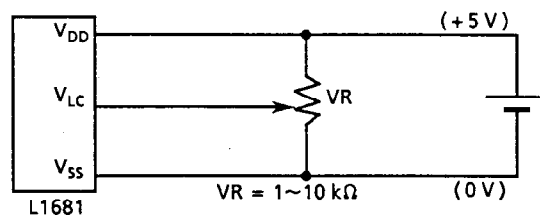
The recommended value of ( $V_{opr}$ ) for an ambient temperature is as follows.

$V_{opr} = V_{DD} - V_{LC}$

Temperature(°C)	0	25	50
$V_{opr}$ (V)	5.00	4.75	4.40

**L1681****■ STN Reflective type**

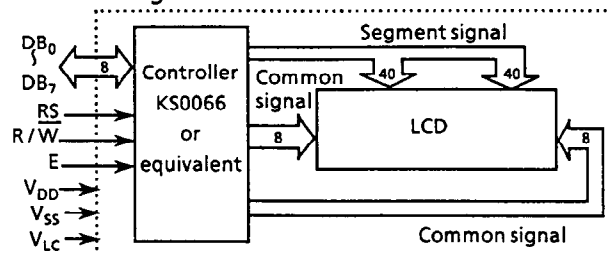
Item	L168100J200
Mechanical Characteristics	A
Absolute Maximum Ratings	B
Electrical Characteristics	C
Optical Characteristics	D-1
Recommended Operating Voltage	E

**F-2 Dimensions****F-1 Power Supply**

Unit : mm

General tolerance :  $\pm 0.5$ **F-3 Pin Functions**

No.	Name	Function
1	V <sub>SS</sub>	GND
2	V <sub>DD</sub>	Power supply voltage + 5 V
3	V <sub>LC</sub>	Liquid crystal driving voltage
4	RS	L: Instruction code input, H: Data input
5	R/W	L: Data write (LCM $\leftrightarrow$ MPU), H: Data read (LCM $\leftrightarrow$ MPU)
6	E	Enable
7	DB <sub>0</sub>	Data bus line
8	DB <sub>1</sub>	Data bus line
9	DB <sub>2</sub>	Data bus line
10	DB <sub>3</sub>	Data bus line
11	DB <sub>4</sub>	Data bus line
12	DB <sub>5</sub>	Data bus line
13	DB <sub>6</sub>	Data bus line
14	DB <sub>7</sub>	Data bus line

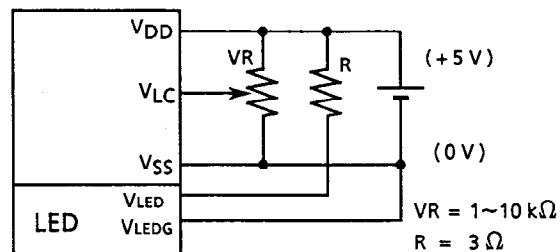
**F-4 Block Diagram**

# L1681

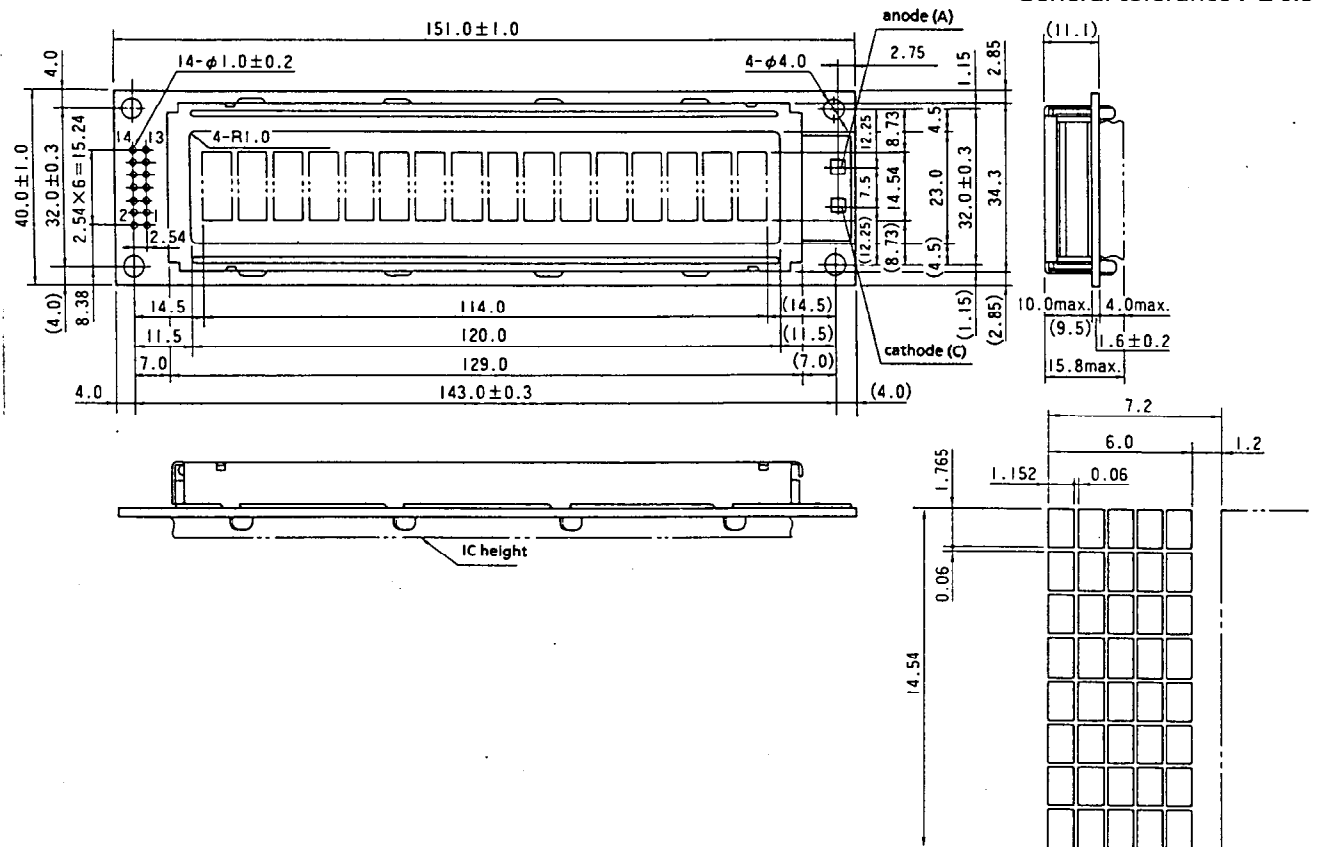
## ■ STN Transflective, Built-in LED Backlight type

Item	L1681B1J200
Mechanical Characteristics	A
Absolute Maximum Ratings	B
Electrical Characteristics	C
Optical Characteristics	D-2
Recommended Operating Voltage	E

### G-1 Power Supply



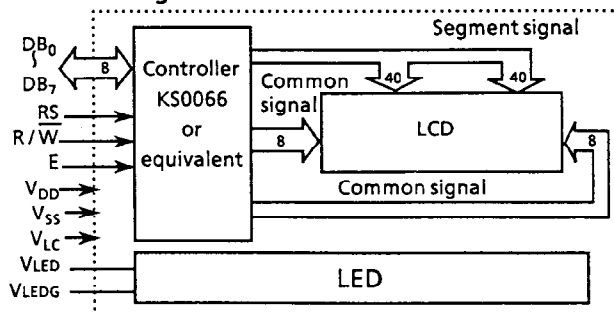
### G-2 Dimensions



### G-3 Pin Functions

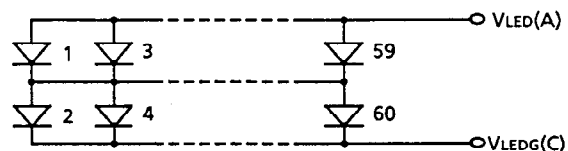
No.	Name	Function
1	V <sub>SS</sub>	GND
2	V <sub>DD</sub>	Power supply voltage + 5 V
3	V <sub>LC</sub>	Liquid crystal driving voltage
4	RS	L: Instruction code input, H: Data input
5	R/W	L: Data write (LCM → MPU), H: Data read (LCM → MPU)
6	E	Enable
7	DB <sub>0</sub>	Data bus line
8	DB <sub>1</sub>	Data bus line
9	DB <sub>2</sub>	Data bus line
10	DB <sub>3</sub>	Data bus line
11	DB <sub>4</sub>	Data bus line
12	DB <sub>5</sub>	Data bus line
13	DB <sub>6</sub>	Data bus line
14	DB <sub>7</sub>	Data bus line

### G-4 Block Diagram



### G-5 LED Backlight

#### G-5-1 LED Circuit Diagram

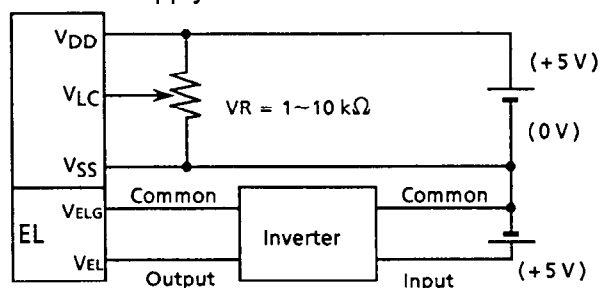


$T_a = 25^\circ\text{C}$ 

\* LED forward current consumption and operating temperature characteristics are as follows.

 $T_a = 25^\circ\text{C}$  $T_a = 25^\circ\text{C}$ 

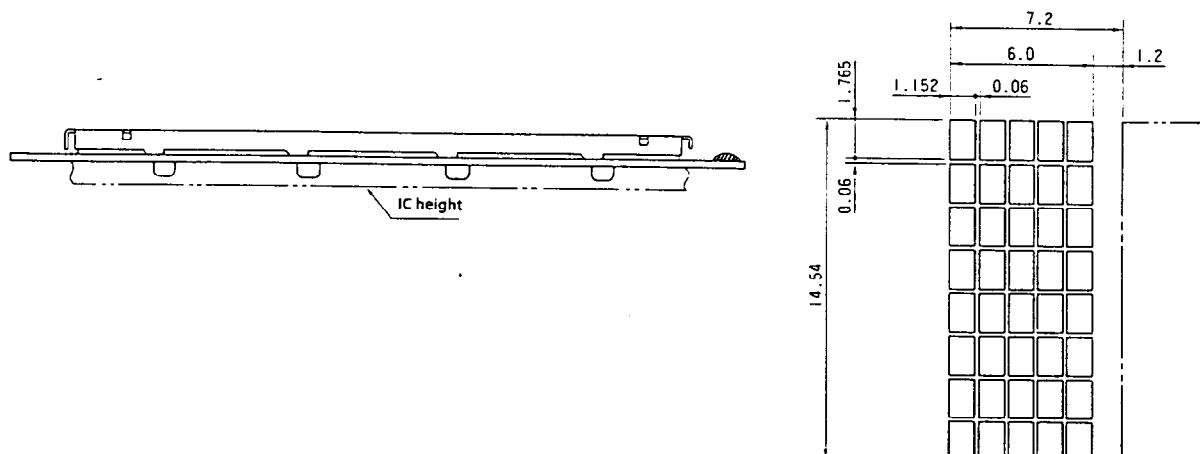
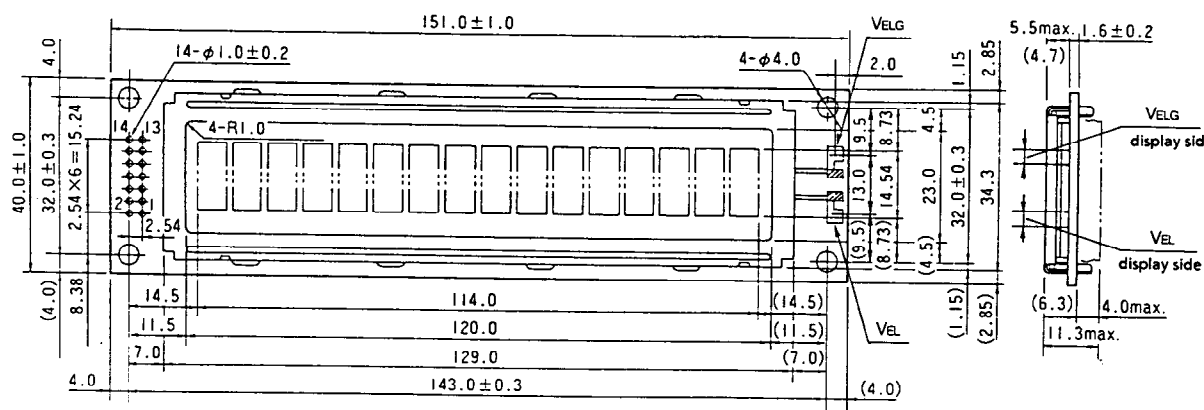
## H-1 Power Supply



Unit : mm

General tolerance :  $\pm 0.5$

## H-2 Dimensions

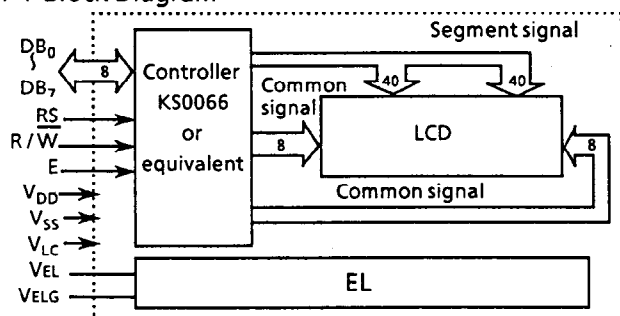


# L1681

## H-3 Pin Functions

No.	Name	Function
1	V <sub>SS</sub>	GND
2	V <sub>DD</sub>	Power supply voltage + 5 V
3	V <sub>LC</sub>	Liquid crystal driving voltage
4	RS	L: Instruction code input, H: Data input
5	R/W	L: Data write (LCM → MPU), H: Data read (LCM → MPU)
6	E	Enable
7	DB <sub>0</sub>	Data bus line
8	DB <sub>1</sub>	Data bus line
9	DB <sub>2</sub>	Data bus line
10	DB <sub>3</sub>	Data bus line
11	DB <sub>4</sub>	Data bus line
12	DB <sub>5</sub>	Data bus line
13	DB <sub>6</sub>	Data bus line
14	DB <sub>7</sub>	Data bus line

## H-4 Block Diagram



## H-5 EL Lamp (white)

### H-5-1 Environmental Characteristics

Item	Symbol	Conditions	Specifications
Operating temperature range	T <sub>opr</sub>		-20°C to +50°C
Storage temperature range	T <sub>stg</sub>		-20°C to +60°C
Soldering heat-resistance		270°C ± 5°C, 3 s max.	No terminal abnormality
Thermal shock		-20°C 30 min. → +60°C 30 min. 5 cycles	No defect on appearance

### H-5-2 Electrical Characteristics

Item	Symbol	Conditions	Specifications	Unit
Electrostatic capacity	C <sub>EL</sub>	f = 1 kHz (in darkroom) 1 VAC	8.5 typ.	nF
Current	I <sub>EL</sub>	When applying rated voltage, 20°C, 70%RH	5.0 max. 3.5 typ.	mA
Maximum rated voltage	V <sub>EL1</sub>	Sine wave, 1 kHz	150	Vrms
Rated voltage	V <sub>EL2</sub>	Sine wave, 400 Hz	100	Vrms
Isolation voltage		Between lead and film Sine wave, 50 Hz, 1 min.	1500	Vrms

## H-5-3 Emission Characteristics

Item	Conditions	Specifications	Unit
Initial brightness(B)	When applying rated voltage 20°C, 70%RH (in darkroom)	40 min. 50 typ.	cd/m <sup>2</sup>
Service life when applying rated voltage	Used continuously down to half of initial brightness 20°C, 70%RH	1500	h
Service life when used with an inverter	Used continuously down to half of initial brightness 20°C, 70%RH	3500	h
Color of light		White	—
Chromaticity coordinates	When applying rated voltage 20°C, 70%RH (in darkroom)	x = 0.315 typ. y = 0.375 typ. x = 0.285 min. y = 0.345 min. x = 0.355 max. y = 0.415 max.	—

## H-6 Suitable Inverter 5C

### H-6-1 Electrical Characteristics (when combined with EL lamp)

Item	Symbol	Conditions	Specifications	Unit
Oscillating frequency	f <sub>INV</sub>	Ta = 25°C, V <sub>IN</sub> = 5 VDC	480 typ.	Hz
Output voltage	V <sub>OUT</sub>	Ta = 25°C, V <sub>IN</sub> = 5 VDC	85 typ.	V
Output current	I <sub>OUT</sub>	Ta = 25°C, V <sub>IN</sub> = 5 VDC	3.5 typ.	mA
Input current	I <sub>IN</sub>	Ta = 25°C, V <sub>IN</sub> = 5 VDC	35 typ.	mA
Input voltage	V <sub>IN</sub>		5 typ.	V DC
Initial brightness	B	Ta = 25°C, V <sub>IN</sub> = 5 VDC	50 typ.	cd/m <sup>2</sup>
Surface brightness (panel upper side)	B <sub>p</sub>	Ta = 25°C, V <sub>IN</sub> = 5 VDC V <sub>opr</sub> = 0 V	5 typ.	cd/m <sup>2</sup>

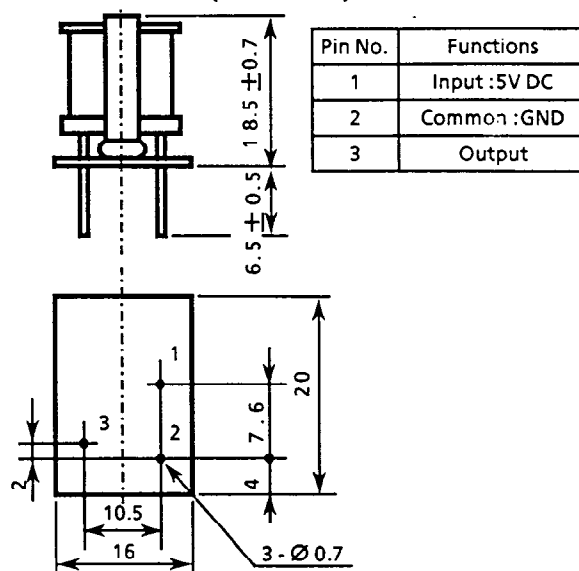
### H-6-2 Tolerance (inverter only)

Item	Specifications	Unit
Input voltage	3.0 to 6.0	V
Load range	25 to 40	cm <sup>2</sup>

### H-6-3 Maximum ratings (inverter only)

Item	Specifications	Unit
Input voltage	7.0	V
Load range	50	cm <sup>2</sup>
Operating temperature range	-10 to +60	°C
Storage temperature range	-20 to +70	°C

### H-6-4 Dimensions (Unit: mm)



**L1681****Wide Temperature Range STN LCD Module****■ Specification****J. Absolute Maximum Ratings**

$V_{SS} = 0V$

Item	Symbol	Conditions	Min.	Max.	Unit
Power supply voltage	$V_{DD}$		-0.3	7.0	V
	$V_{LC}$		$V_{DD} - 13.5$	$V_{DD} + 0.3$	V
Input voltage	$V_{IN}$		-0.3	$V_{DD} + 0.3$	V
Operating temp.	$T_{opr}$		-20	+70	°C
Storage temp.	$T_{stg}$		-30	+80	°C
Storage humidity		≤ 48 hrs	+20	+85	%RH
		≤ 1000 hrs	+20	+65	%RH

**K. Electrical Characteristics**

$V_{DD} = 5V \pm 5\%$   $V_{SS} = 0V$   $T_a = -20^\circ\text{C to } +70^\circ\text{C}$

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	$V_{DD}$		4.75	5.00	5.25	V
	$V_{DD} - V_{LC}$		1.5	—	11.0	V
* Input voltage	High $V_{IH1}$		2.2	—	$V_{DD}$	V
	Low $V_{IL1}$		0	—	0.6	V
** Output voltage	High $V_{OH1}$	$I_{OH} = 0.205\text{ mA}$	2.4	—	—	V
	Low $V_{OL1}$	$I_{OL} = 1.2\text{ mA}$	—	—	0.4	V
Current consumption	$I_{DD}$	$T_a = 25^\circ\text{C}$ $V_{DD} = 5V$ $V_{LC} = 0.2V$	—	1.8	3.0	mA
	$I_{LC}$		—	0.3	1.0	mA
Clock oscillation frequency	$f_{osc}$	Resistance oscillation	140	220	300	kHz

\* Applied to DB<sub>0</sub>~DB<sub>7</sub>, E, R/W, RS\*\* Applied to DB<sub>0</sub>~DB<sub>7</sub>**L. Optical Characteristics**

The background color is affected by ambient temperature, and the response characteristics deteriorates at low temperature.

**• Reflective/transflective type**

$T_a = 25^\circ\text{C}, V_{opr} = 4.8V, \text{ Backlight OFF}$

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Viewing angle	$\theta_1$	$C \geq 2.0$ $\phi = 0^\circ$	—	—	-10	deg.
	$\theta_2$		40	—	—	
	$\theta_2 - \theta_1$		50	—	—	
Contrast	C	$\theta = 5^\circ, \phi = 0^\circ$	2	3	—	—
Response time(rise)	$t_{on}$	$\theta = 0^\circ$	—	50	80	ms
Response time(fall)	$t_{off}$	$\phi = 0^\circ$	—	100	160	
Response time(rise)	$t_{on}$	$\theta = 0^\circ, \phi = 0^\circ$ $T_a = 0^\circ\text{C}$ $V_{opr} = 4.9V$	—	200	320	ms
Response time(fall)	$t_{off}$		—	450	720	
Response time(rise)	$t_{on}$	$\theta = 0^\circ, \phi = 0^\circ$ $T_a = -20^\circ\text{C}$ $V_{opr} = 5.0V$	—	1500	2400	ms
Response time(fall)	$t_{off}$		—	1500	2400	

**M. Recommended Operating Voltage**

The recommended value of ( $V_{opr}$ ) for an ambient temperature is as follows.

$V_{opr} = V_{DD} - V_{LC}$

Temperature(°C)	-20	0	25	70
$V_{opr}$ (V)	5.0	4.9	4.8	4.2

**■ Reflective type**

Item	L168100P200
Mechanical Characteristics	A
Absolute Maximum Ratings	J
Electrical Characteristics	K
Optical Characteristics	L
Recommended Operating Voltage	M
Reflective type	
Power Supply	F-1
Dimensions	F-2
Pin Functions	F-3
Block Diagram	F-4

**■ Built-in LED Backlight type**

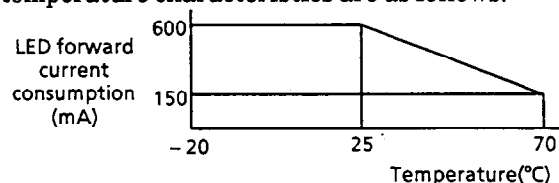
Item	L1681B1P200
Mechanical Characteristics	A
Absolute Maximum Ratings	J
Electrical Characteristics	K
Optical Characteristics	L
Recommended Operating Voltage	M
Transflective Built-in LED Backlight type	
Dimensions	G-2
Pin Functions	G-3
Block Diagram	G-4
LED Circuit Diagram	G-5-1
Electrical Characteristics (LED)	G-5-3

**P. LED Backlight****P-1 Absolute Maximum Ratings**

$T_a = 25^\circ\text{C}$

Item	Symbol	Specifications	Unit
LED forward current consumption*	$I_F$	600	mA
LED reverse voltage	$V_R$	8	V
LED allowable dissipation	$P_D$	2.6	W

\* LED forward current consumption and operating temperature characteristics are as follows.

**P-2 Optical Characteristics**

$T_a = 25^\circ\text{C}$

Item	Symbol	Conditions	Specifications	Unit
Surface brightness (panel upper side)	$B_P$	$I_F = 300\text{ mA}^*$ $V_{opr} = 0V$	4.5 min. 5 typ.	cd/m <sup>2</sup>
LED brightness	L	$I_F = 300\text{ mA}^*$	40 min. 50 typ.	cd/m <sup>2</sup>
LED service life			50,000 typ.	h
LED color				

\* The forward current depends upon the temperature. Especially, it must be decreased at high temperature. For temperature dependence, refer to forward current reduction characteristics.